REMARKS

Applicant hereby responds to Office Action of October 4, 2006, in the above-referenced patent application. Claims 22-39 are pending in the above-referenced patent application. Claims 22 and 39 are independent. Claims 1-21 were withdrawn from consideration by the Examiner.

Claims 22-30, 32, 33, 36 and 39 were rejected under 35 USC 103(a) as being unpatentable over Kusakabe et al, US 2005/0031223 A1,2/2005 (hereinafter "Kusakabe"). Claims 31, 34, 35, 37 and 38 were objected to as being dependent on a rejected base claim, but were deemed allowable if rewritten in independent form including limitations of the base claim and any intervening claims. Applicant wishes to thank the Examiner for detailing the allowable claims. Claims 25 and 26 have been amended to further clarify the claimed limitations. New matter has not been added.

Rejection of claims 22-30, 32, 33, 36 and 39 under 35 USC 103(a) as being unpatentable over Kusakabe is respectfully traversed because, for at least the following reasons, Kusakabe does not teach or suggest all of the limitations of each claim. None of the claimed limitations, which the Examiner concludes as obvious to one of ordinary skill in the art is suggested by Kusakabe or is known to one of ordinary skill in the art.

Kusakabe is directed to an image processing apparatus which removes conspicuous noise contained in the image. A parameter determination module (103) determines predetermined parameters used in a noise removal process, based on resolution or enlargement ratio upon

outputting image data. An individual noise removal module (104) removes noise contained in the image data using the parameters. Kusakabe performs noise removal by a noise distribution process, wherein visible noise in a window is distributed in the window (para 0100). A difference between RGB values of an arbitrarily selected pixel and a pixel of interest is determined, wherein if the difference is smaller than a threshold value, then the pixel of interest is substituted by the arbitrarily selected pixel, otherwise it is not substituted (para 0107). The threshold value for substitution is determined by module 103 based on output image resolution (para 0103). As the Examiner also states, Kusakabe does not teach or suggest ringing artifacts.

By contrast, according to the claimed invention herein, subsets of an input image are analyzed as one or more windows. For each such window in the input image, if the window is around a detected ringing-like area in the image, then a smoothed version of the pixels in the window are selected for output. However, if the window is not around a ringing-like area, then the pixels in the window (from the input image) are selected for output. Therefore, the output image includes portions of the input image in which ringing artifacts were not detected, and includes smoothed pixels corresponding to portions of the input image where ringing artifacts were detected, whereby ringing-like artifacts of the input image are suppressed in the output image.

As per Claim 22 it is respectfully submitted that despite the Examiner's interpretation, Kusakabe does not disclose: "a ringing-artifact detector that detects areas of ringing artifacts in a pixel window based on the pixel information, the pixel window including a set of pixels from the

input image pixels; an image processor that processes window pixels to generate pixels with reduced ringing artifacts", as claimed herein.

In para 89-92 (relied on by the Examiner), Kusakabe mentions noise removal effects and adverse effects with respect to the processing ranges and weights in an LPF process in relation to FIGS. 6A to 6D, FIGS. 7A to 7C, and FIGS. 8A to 8H. There is no mention of ringing artifact detection. Further, in para 93 (relied on by the Examiner), Kusakabe discusses visual conspicuity of adverse effects (which the Examiner is interpreting as blurring) after application of Kusakabe's noise removal process. Kusakabe mentions that these adverse effects vary depending on the resolution upon displaying or printing a noise-removed output image. As such, Kusakabe teaches away from the claimed limitations because Kusakabe's noise removal in fact introduces adverse effects of blurring, whereas the claimed invention reduces ringing artifacts. There is no teaching or suggestion in Kusakabe of a ringing-artifact detector that detects areas of ringing artifacts in a pixel window based on the pixel information, the pixel window including a set of pixels from the input image pixels, and an image processor that processes window pixels to generate pixels with reduced ringing artifacts, as claimed.

Indeed element 104 in Kusakabe is a noise removal unit (e.g., paras 0037, 0057), and does not perform any ringing-artifact detection in a pixel window based on the pixel information, as claimed. And, as mentioned, in para 0107 Kusakabe discusses determining a difference between RGB values of an arbitrarily selected pixel and a pixel of interest. There is no disclosure in Kusakabe that this difference indicates ringing artifacts, or that the difference is used to determine ringing artifacts, as claimed. In paras 0014-0015 Kusakabe states that

an image processing apparatus inputs noisy image data and an output condition, and removes noise in the image using a predetermined parameter that is based on the output condition. There is no teaching or suggestion in Kusakabe of an image processor that processes window pixels to generate pixels with reduced ringing artifacts after a ringing-artifact detector detects areas of ringing artifacts in the pixel window, as claimed.

Further, Kusakabe states that FIG. 11A shows an image state as a result of the noise distribution process using pixel window 602 as the processing range for the image in FIG. 6A (para 0112). Kusakabe (para 0113) states that in FIG. 11A, reference numeral 1100 denotes pixels, which belonged to the non-noise region 601 before the noise distribution process, but to which the pixel values of the noise region are distributed as a result of the noise distribution process. Reference numeral 1101 denotes pixels, which belonged to the noise region 600 before the process, but which are replaced by pixel values of the non-noise region 601 since the noise region is distributed as a result of the noise distribution process. Kusakabe than states (para 0115) that FIG. 11B shows an image state as a result of the noise distribution process which is executed using pixel window 603 as the processing range for the image in FIG. 6A. In FIG. 11B, the noise distribution process is done using the processing region which is large enough with respect to the size of the noise region 600. For this reason, the central portion of the noise region 600 undergoes pixel value substitution, and a cluster of noise components, which are readily visually detectable, are distributed, thus obtaining a noise removal effect.

Based on the description of FIGS. 11A-B in Kusakabe, there is no disclosure therein about an image processor that processes window pixels to generate pixels with reduced ringing

artifacts. Noise distribution to simulate a noise removal effect in Kusakabe is different from, and does not teach or suggest, reducing ringing artifacts, as claimed. Indeed, such noise distribution can have adverse effects and introduce blurring, as Kusakabe itself discloses.

Further, Kusakabe (para 0015, para 0113, para 0122-0124 and Fig. 11), does not disclose a combiner, as claimed. As discussed, para 0015 only generally refers to a noise removal apparatus. Further, para 0113, 0122-0124 in Kusakabe mention noise removal by a noise distribution process. As discussed, the noise distribution process involves determining the difference between RGB values of an arbitrarily selected pixel and of a pixel of interest. If the difference is smaller than a threshold value, then the pixel of interest is substituted by the arbitrarily selected pixel, otherwise it is not substituted. As such, noise in the window is distributed around in the window (para 0100).

There are no pixels in Kusakabe that are processed to reduce their ringing artifacts. Rather the pixels in Kusakabe are distributed around to distribute noise in the window. Substituting a pixel of interest in the window with a randomly selected pixel according to Kusakabe, is not the same as reducing ringing artifact of the pixel of interest, as claimed. The Patent Office has the burden of showing that redistributing noise in Kusakabe is the same as the claimed limitations of removing ringing artifacts (e.g., by a smoother or low pass filter). Instead, the Office Action is improperly placing such a burden on the Applicant.

Further, there is no disclosure in Kusakabe of selecting processed pixels with reduced ringing artifacts in the detected ringing-artifact areas. As discussed, Kusakabe does not detect

ringing artifact areas in the window. In addition, Kusakabe simply distributes noise in the window by substituting a pixel of interest with a randomly selected one (by comparing their difference to a threshold). As such, Kusakabe cannot, and does not, generate an output image comprising: (i) selected processed pixels with reduced ringing artifacts, and (ii) remaining window pixels from the input image. In other words, Kusakabe does not generate an output image that includes portions of the input image where ringing artifacts were not detected, and portions of the processed image corresponding to areas in the input image where ringing artifacts were detected, such that the output image is an enhanced version of the input image with ringing artifacts substantially reduced, as claimed.

Kusakabe does not teach or suggest detection and reduction of ringing artifacts as claimed. One of ordinary skill in the art will not look to Kusakabe for the claimed limitations, and indeed as discussed above, Kusakabe teaches away from the claimed invention. Applicant respectfully traverses the Examiner's conclusion that inclusion of ringing artifacts with the method of Kusakabe would be obvious since indeed Kusakabe's noise distribution method causes adverse effects of blurring in the image which Kusakabe must address. Whereas, the claimed invention reduces ringing artifacts instead of introducing blurring. The conclusion drawn by the Examiner is not supported by the cited reference. The pixel evaluation step for detecting blur is not disclosed in Kusakabe, and does not teach or suggest reducing ringing artifacts. Indeed, if according to the Examiner blurring and ringing artifacts are the same, then unlike the claimed invention, the noise removal process of Kusakabe introduces ringing artifacts. For at least the above reasons, it is respectfully submitted that Claim 22 and all claims dependent therefrom (Claims 23-38), are allowable.

As per Claim 23, Kusakabe does not disclose the ringing-artifact detector comprises a pattern detection function that detects ringing pattern-like features indicating the areas of ringing in the pixel window as a function of gradation level differences between one or more pixels therein, as claimed. Kusakabe (para 0109, 0127, fig. 13, relied on by the Examiner), mentions the pixel values to be used for determining said pixel difference value for noise removal by noise distribution, and further varying the noise distribution amount by selecting said window size, and said threshold, based on output image resolution. There is disclosure in Kusakabe, whatsoever, of gradation levels, or determining areas of ringing based on gradation levels in Kusakabe. Further, para 0085 of Kusakabe simply mentions an edge in FIG. 7A, without any teaching or suggestion of a pattern detection function that detects ringing pattern-like features indicating the areas of ringing in the pixel window as a function of gradation level differences between one or more pixels therein, as claimed.

As per Claim 24, Kusakabe (pare 0137, para 0169, relied on by the Examiner), does not disclose that: "the ringing-artifact detector determines the gradation level difference between a pixel and that of neighboring pixels, and detects if the gradation level difference is within a selected threshold, indicating ringing-like artifacts proximate that pixel position in the window," as claimed. In para 0137, Kusakabe simply mentions said RGB difference values, which as discussed, do not disclose gradation level difference. Further, in Kusakabe said RGB difference is between a pixel of interest and a randomly selected pixel, whereas as claimed herein, a gradation level difference is determined between a pixel of interest and neighboring pixels.

In addition, in para 0169, Kusakabe simply mentions that a granularity is more likely to be visually recognized depending on the resolution upon displaying or printing an image. Hence, when the granularity is visually conspicuous in correspondence with the output resolution, parameters are determined to adjust noise removal to reduce adverse effects of noise removal based on output image resolution that is used to select said threshold value for noise distribution by pixel substitution of Kusakabe, as discussed above. This has nothing to do with determining ringing artifacts areas by comparing gradation level differences to a threshold, as claimed.

As the Examiner also states, Kusakabe does not disclose determining gradation level difference. However, the Examiner concludes that such a feature is obvious. This is respectfully traversed, and the Examiner has not met the burden of proof. As discussed, Kusakabe does not even disclose a ringing artifact detector as claimed, and certainly there is no suggestion or motivation therein to modify Kusakabe to determine the gradation level difference between a pixel and that of neighboring pixels, and detect if the gradation level difference is within a selected threshold, indicating ringing-like artifacts proximate that pixel position in the window. The Office Action has not met the burden of showing that ringing artifacts as claimed and image deterioration in Kusakabe are the same.

As per Claim 25, it is respectfully submitted that Kusakabe (para 0008, para 0132, relied on by the Examiner), does not disclose the image processor includes a low pass filter that reduces ringing artifacts, as claimed. In para 0008 Kusakabe generally mentions LPF, and in para 0132, Kusakabe mentions a case wherein noise removal process suppresses its adverse effect by determining the processing ranges and weights used upon calculating the weighted mean on the

basis of conspicuity of the adverse effect of the noise removal process depending on the output resolution in the noise removal process using an LPF. However, Kusakabe does not disclose applying LPF to the original image to generate pixels with reduced ringing artifacts and using detected ringing artifact areas for selecting portion of original image to combine with ringing artifact reduced pixels, as claimed.

As per Claim 26 (as amended), it is respectfully submitted that for at least the above reasons, Kusakabe (para 0008, para 0132, relied on by the Examiner), does not disclose that the image processor includes a smoother that reduces ringing artifacts, as claimed. A smoother is not even mentioned in Kusakabe. Further, Kusakabe (para 0139) states that LPF (relied on by the Examiner) introduces adverse effects which the Examiner interprets as ringing.

As per Claim 27 (as amended), it is respectfully submitted that Kusakabe (para 0107-0109, relied on by the Examiner) does not disclose a variance detector that determines local variance of each pixel in the window with respect to neighboring pixels, wherein the local variances indicate presence of noisy areas in the image, as claimed. In paras 0107-0109, Kusakabe mentions determining the difference between RGB values of an arbitrarily selected pixel and a pixel of interest. If the difference is smaller than a threshold value, then the pixel of interest is substituted by the arbitrarily selected pixel, otherwise it is not substituted. Not only is a local variance not determined for each pixel, but even the different value is between a pixel of interest and an arbitrary pixel, rather than neighboring pixels, as claimed.

Further, Kusakabe (para 0114, 0120, relied on by the Examiner), does not disclose a signal detector that based on the local variances, detects if the location of the window is proximate a noisy area in the input image. The Examiner states that the threshold values of the luminance parameters are used to detect noise/signal when comparing pixels within a window, such that the window size is adjusted during the noise suppression process to sufficiently reduce noise. Applicant traverses this interpretation of Kusakabe by the Examiner. As discussed, in Kusakabe the window size is based on output image resolution in order to reduce adverse effects of noise removal, not based on threshold values for pixel substitution in noise distribution. Further, any window size adjustment in Kusakabe has nothing to do with detecting if the window is proximate to a noise area in the input image, according to the present invention.

Para 87 of Kusakabe (relied on by the Examiner) does not disclose a variance detector that determines local variance of each pixel in the window with respect to neighboring pixels, wherein the local variances indicate presence of noisy areas in the image, as claimed. Indeed, in para 87 of Kusakabe (relied on by the Examiner) states: "FIG. 7C shows the state of an image as the processing result obtained when the LPF process that uses the 9x9 pixel window 603 as the processing range is executed for the image shown in FIG. 7A. In FIG. 7C, the ranges of the regions 702 and 703 where the pixel values are diffused are broadened compared to FIG. 7B. The region 702 or 703 is visually recognized as a blur. For this reason, the region 702 or 703 is preferably narrower since it becomes harder to visually recognize, thus reducing the adverse effect." However, there is no mention or suggestion of local pixel variances, as claimed.

For at least the reasons above, and the reasons discussed in relation to Claim 22, Kusakabe does not disclose the claimed combiner. Further, there is no disclosure in paras 0122-0124, 0016, 0113, of Kusakabe that teaches a combiner that further selects pixels with reduced ringing artifacts from the processed pixels, based on the detected ringing artifact areas and the detected window location information, and generates that enhanced output image comprising: (i) the selected pixels with reduced ringing artifacts, and (ii) the remaining window pixels from the input image, as claimed. Further, in Kusakabe, no window location is detected, only the window size for pixel distribution is changed based on output image resolution in order to reduce adverse effects of noise removal. Location of a window and its size are two different principals and Applicant respectfully traverses the Examiner's conclusion that they are the same. For example, a 3x3 window can have a different location while it remains the same size. In addition, in Kusakabe, no decision as to pixel selection is made based on location of a window.

Indeed, despite the Examiner's position, it is respectfully submitted that in Kusakabe, application of noise removal creates adverse effects of blurring rather than reducing ringing artifacts, as claimed. Further, as the Examiner also states, Kusakabe does not disclose determining local variance of each pixel in the window with respect to neighboring pixels. However, the Examiner concludes, without meeting the burden of proof, that such a feature would have been obvious, and that Kusakabe can be modified to use such a feature since Kusakabe determines difference between a pixel of pixel and a randomly selected pixel. Applicant respectfully disagrees. Kusakabe does not teach that a randomly selected pixel is a neighboring pixel, as claimed. Further, Kusakabe mentions determining a difference, and not a local variance, as claimed. Further, Kusakabe uses the difference for pixel substitution in noise

distribution, whereas the claimed invention uses the local variance for combining to generate an enhanced output image comprising: (i) the selected pixels with reduced ringing artifacts, and (ii) the remaining window pixels from the input image, as claimed.

As per Claim 28, it is respectfully submitted that Kusakabe (para 0122-0124, relied on by the Examiner) does not disclose that the combiner selects pixels with reduced ringing artifacts from the processed pixels in the detected ringing artifact areas, based on the window location information. Kusakabe mentions noise removal by a noise distribution process. As discussed, the noise distribution process involves determining the difference between RGB values of an *arbitrarily* selected pixel and a pixel of interest. If the difference is smaller than a threshold value, then the pixel of interest is substituted by the arbitrarily selected pixel, otherwise it is not substituted. As such, noise in the window is distributed around in the window (para 0100). This has nothing to do with a combiner that selects pixels with reduced ringing, based on window location information.

As per Claim 29 (as amended), for at least the above reasons, Kusakabe (para 0122-0124, relied on by the Examiner) does not disclose that the combiner selects pixels with reduced ringing artifacts from the processed pixels in the detected ringing artifact areas, corresponding to substantially noisy input image locations, as claimed.

As per Claim 30 (as amended), Kusakabe does not disclose that the input image comprises a decompressed image, such that said ringing artifacts were generated by image compression and/or decompression, as claimed. Despite the Examiner's interpretation, even the

word compress or the concept of ringing artifacts due to image compression and/or decompression, does not appear anywhere in Kusakabe.

As per Claim 31, Applicant respectfully requests clarification since Claim 31 seems to have been deemed allowable, and rejected at the same time.

As per Claim 32, as discussed, Kusakabe para 107-109 discusses noise redistribution by determining a difference between pixel of interest and a randomly selected pixel. There is no disclosure that the variance detector determines the local deviation in the image, as claimed.

Claim 33 was rejection for the same reasons as rejection of Claim 27, and should therefore be allowed for at least the reasons provided in relation to Claim 27.

Claim 36 was rejected for essentially the same reasons as Claims 22 and 27, and should therefore be allowed for at least the reasons provided in relation to Claims 22 and 27.

Claim 39 was rejected for essentially the same reasons as Claims 22, 27 and 36, and should therefore be allowed for at least the reasons provided in relation to Claims 22, 27 and 36.

None of the limitations which the Examiner concludes as obvious to one of ordinary skill in the art (without support in qualified prior art or otherwise) is suggested by Kusakabe or is known to one of ordinary skill in the art. No motivation is suggested by Kusakabe for the modifications proposed by the Examiner. Indeed, Kusakabe teaches away from the claimed

invention and from the proposed modifications by the Examiner.

CONCLUSION

For these, and other, reasons, Applicants believe that the claims are in condition for allowance. Reconsideration, re-examination, and allowance of all claims are respectfully requested.

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: MS Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on: January 4, 2007.

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Respectfully submitted,

1/4/7

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